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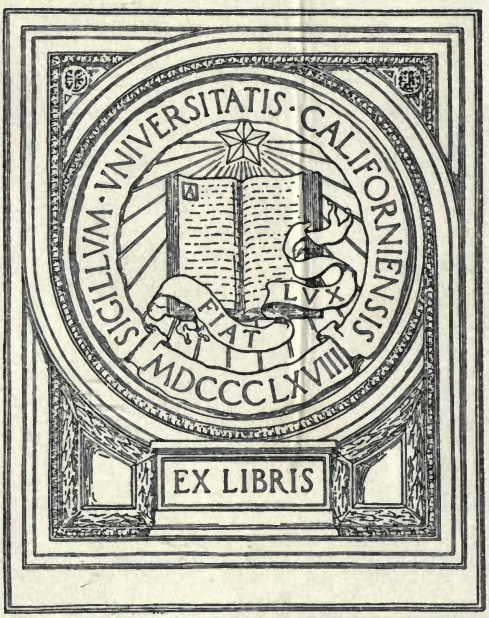


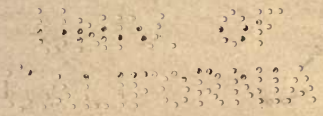
"THE fate of the world may have hung by a thread at times during the crowded years of the war, but it hung by a wire rope pretty nearly all of the time"

One of the 70,000 mines that blocked the northern entrance to the North Sea

manufacturers

Wire-Roping the German Submarine

The Barrage That Stopped the U-Boat



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FOREWORD

What every American industry did in the war is of interest to the American people.

What a particular industry did is of even keener interest to those engaged in it, and to those with whom they have relations.

Furthermore, every industry owes it to itself to record for the benefit of posterity the part it played in the greatest struggle that ever tested the moral fibre of mankind.

For these reasons this booklet has been prepared by one of those American institutions which had a part in supplying the wire rope needs of the Allies.

JOHN A. ROEBLING'S SONS CO.
TRENTON, N. J.

March 1, 1920

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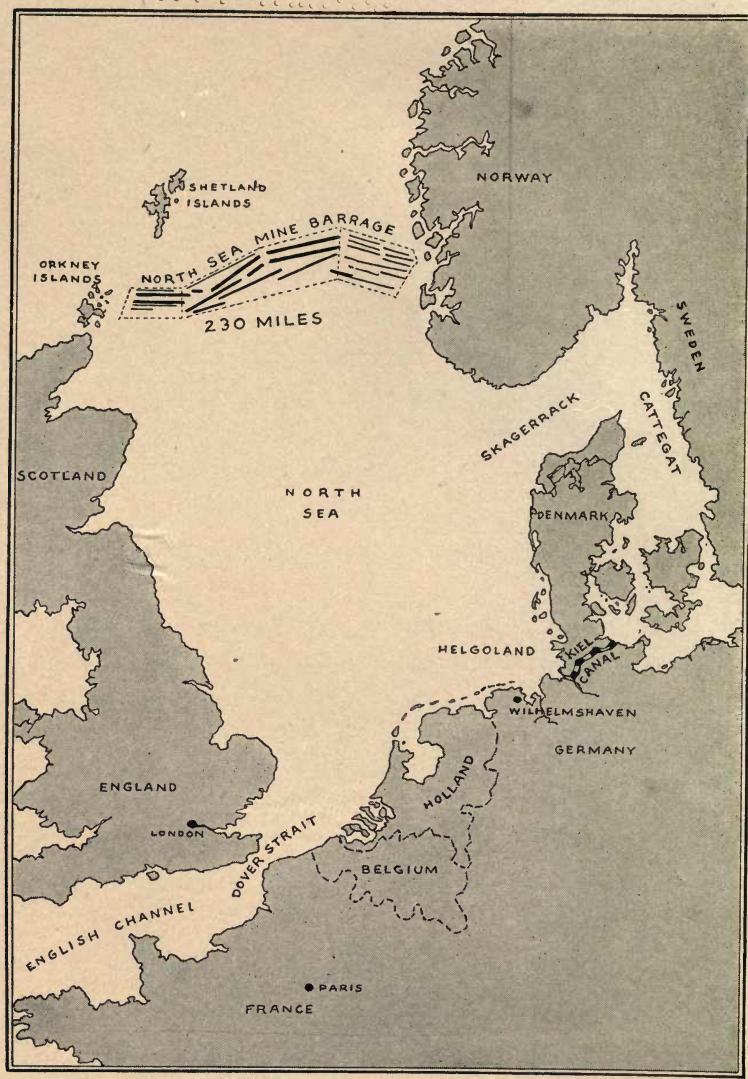


The North Sea Mine Barrage

THE BARRAGE THAT STOPPED THE U-BOAT

Extracts from an Article by Captain Reginald R. Belknap, U. S. N., Commander of the U. S. Mine-laying Squadron. From the Scientific American, March 15-22, 1919.

IN Admiral Sims' address, just before the American Mine-laying Squadron left Portland, England, for home, he said, "After we came into the war we designed a mine, built it, equipped the mine layers, sent them over to this side, and planted more mines in less space of time than any nation in the world ever thought of doing before—one of the finest stunts the Navy has accomplished on this side.

Reducing a new invention to practice in a few months is no small problem, especially when it is a mine to be planted much deeper, and over bottom 100 fathoms deeper than ever before—yet this had to be done to meet the enemy's submarine campaign, the most serious menace to the cause of America and the Allies.

Briefly, the project was for the United States and British mining forces to co-operate in establishing a mine-field barrier across the North Sea between Scotland and Norway. The mine-field would measure 230 miles long by 25 average width, consist of 70,000 mines in "systems," each comprising one or more lines of mines near the surface, other mines deeper, and yet more, deeper still, so as to bar or imperil the passing of any vessel, whether on the surface or submerged.

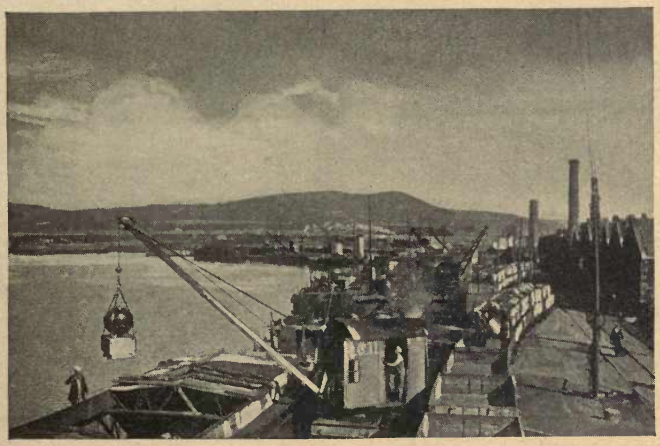
The terms "impossible" and "foolish" were freely applied to the scheme. Contracts for 100,000 mines would have to be let, and tens of millions more spent outright, both here and in Great Britain, based on test of the mine only by parts, since a complete new mine did not yet exist. But in spite of the several elements of uncertainty, the undertaking had the unqualified approval of everyone in authority, from the President down.

Secrecy, as well as haste, necessitated dividing the construction of the mine among 500 contractors and sub-contractors. Parts manufactured in different places were sent to a third place for joining, and all were finally sent to Norfolk, Virginia, whence they were shipped to Scotland, where the mines would be assembled complete for the first time, ready for planting. The mine spheres were charged with high explosive at a plant near Norfolk, containing large steam kettles, which poured 300 pounds of molten TNT into each sphere. In this quiet corner the sailors worked in constant danger from fire and the poisonous fumes of the molten explosive. Several were seriously overcome and one died from the effects, but the rest stuck to it through the long, hot summer.

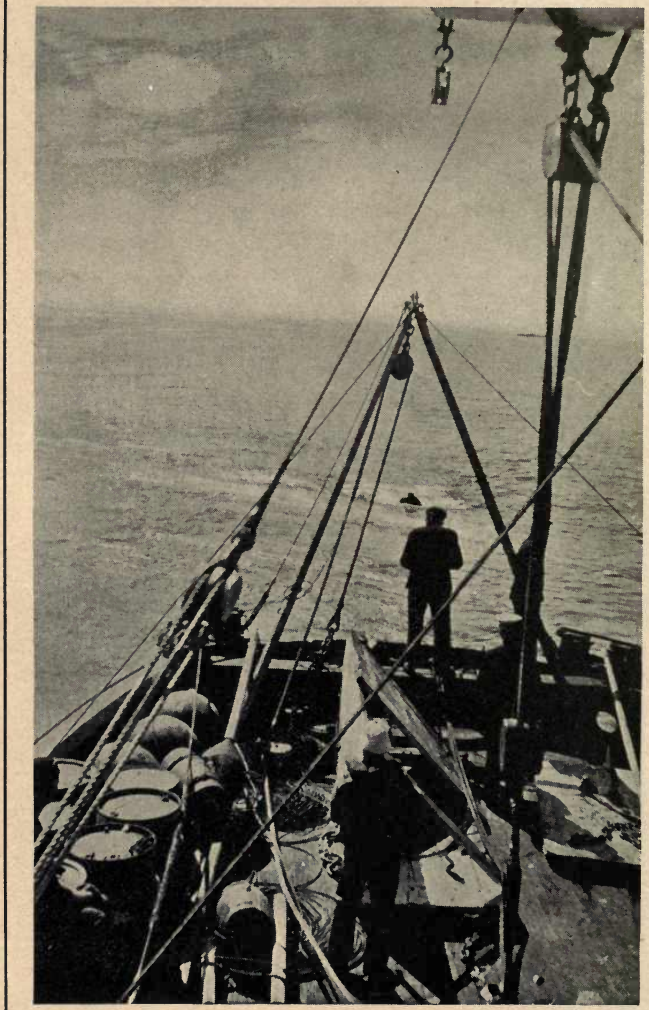
To carry the mine material over, small steamers were chosen to minimize the effect on the operation in case of loss. One, the "Lake Moor," was sunk by a submarine in April, with forty-one of her crew, making almost the only loss of life in the whole operation. They had capacity of 2,000 to 3,000 tons and carried 1,200 to 1,800 mines, besides stores of various kinds. Our mine-laying squadron and bases were supplied almost entirely from America, obtaining

abroad little more than fuel, fresh meat and vegetables. There were twenty-four of these carrier steamers constantly employed, from February on, two or three sailings every eight days.

Before the first system of the barrier was half way across the North Sea, reports of damage to the enemy began to come in. This was in early July, and before October ten submarines had been destroyed in the barrier and probably many more. From the very circumstances in that vicinity, the actual toll may never be known. The latest report is that the Germans admit twenty-three lost there and other authorities ascribe the fleet's surrender and the final armistice largely to the defeat of the submarine campaign which the Northern Mine Barrage forced the enemy to accept.



Loading mines on scows to be transferred to ships of the mine-laying squadron



A loose mine astern of a mine sweeper

Wire-Roping the German Submarine

THE whole amazing episode of the North Sea Mine Barrage which, with its 70,000 bottled volcanoes, made that historic water a graveyard for German hopes, was hidden from general knowledge, even down to the removal, by the "smoke-screen" of secrecy which is traditional in the Navy.

While the armies in all theatres swayed back and forth in the world struggle, the spot-light of publicity never left them.

"MUM" WAS THE NAVY'S WATCHWORD

The navies, others as well as our own, did their work, some great, some small, but all important, in the dark so far as public knowledge was concerned.

The naval specialty was keeping still about it.

Not until the "moving finger" had written failure across the German plans was any whisper allowed to escape regarding the great work that was done in making the submarine warfare ineffective.

What makes it still more impressive is that the work of creating the barrage involved so many men and so many classes of men. Thousands of heads and hands were at work helping to put it through, but it remained a secret until the job was done.

Now that the last steel-jacketed bundle of TNT has been gathered up and put out of commission, making the sea again a pathway for peaceful commerce, there are many things which may be revealed as part of the record of the accomplishment, which add to its magnitude and its value.

THE FATE OF THE WORLD HUNG BY A WIRE ROPE

The fate of the world, for example, may have hung by a thread at times during the crowded years of the war, but it hung by a wire rope pretty nearly all the time.

Wire rope has come to be so much of a commonplace in the everyday work of the world that it is taken for granted. To the man in the street it has no dramatic value. People accept it as a matter of course.

There is a thrill in the picture, and even in the thought of men and ships sowing a perilous seaway with high explosive so thickly that a fish would be ill-advised to navigate it.

The devising and the laying of this deadly barrier, with all it meant, will go down in history as a deed of signal ingenuity and daring, and its removal as a desperately ticklish job, done with conspicuous efficiency. But who can write a poem or even a rip-roaring chantey about wire rope?

WIRE ROPE IN THE NORTH SEA BARRAGE

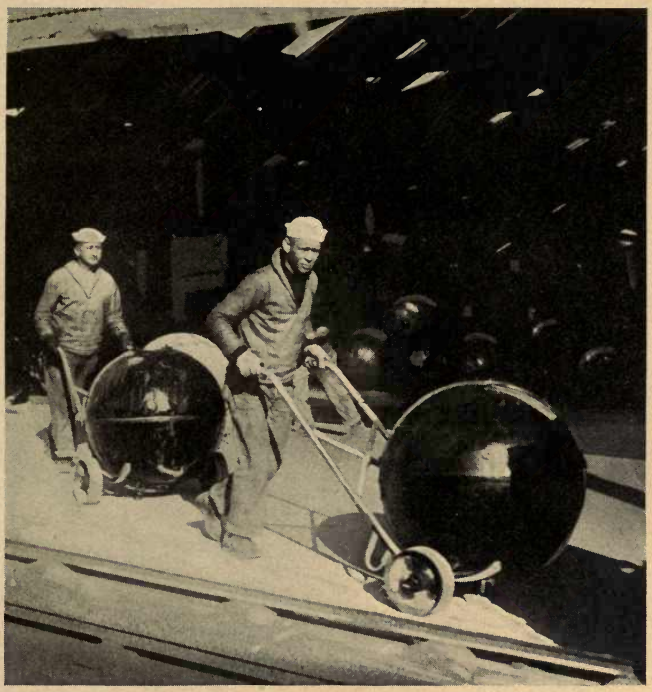
Wire rope, in the epic of the North Sea Barrage, sounds like an incidental, but an outline of the part it played will be of interest to many and will illustrate, as perhaps nothing else could do, the devotion and

efficiency, in a thousand fields, of the thousands of men behind the men behind the mines. In these days of overpowering numerals probably even the figures of wire rope in the war will be read without leaving any clear impression of the unbelievable work they register.

EIGHTY MILLION FEET OF WIRE ROPE

Men who through a good part of their lives have been accustomed to see wire rope on every street and in every mill and every hardware store, may not be greatly impressed by the statement that the North Sea project required approximately eighty million feet of rope. To say that the total war requirement of this country was more than two hundred million feet is no more convincing.

But when one stops to think, by way of preliminary, that the rope used for war purposes was in large measure special sizes, special quality and tests, and that it was nearly all excess over normal production, and, furthermore, that during the time it



Trucking bottled volcanoes at a mine assembling plant

was being produced no industry in the United States was compelled to go without; —the magnitude of the operation which produced it begins to be suggested.

Without wire rope, in quantities and at a rate of production hitherto undreamed of,

the German might today have been dining in the Cafe de la Paix or the Cheshire Cat. Certainly the task of closing the North Sea to German submersibles and to other enemy ships as well, could not have been undertaken, much less accomplished.

A WORK OF UNDREAMED OF MAGNITUDE DONE AT TOP SPEED

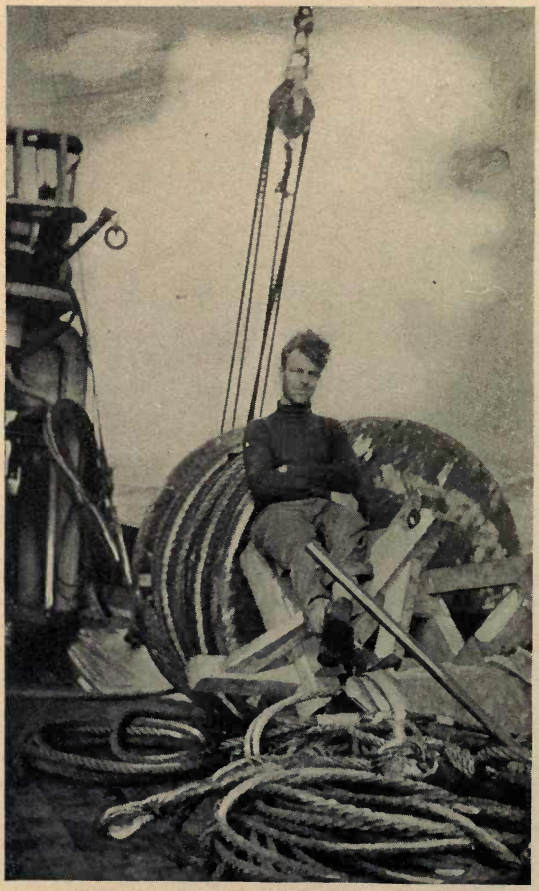
The same may be said with truth of other factors in this and divers war operations, but the swiftness with which the barrage project was executed, the brief time allowed for the fulfillment of unheard of demands, the small number of plants in which the work had to be done, many of them far from the point of shipment, the highly specialized equipment and processes employed in the manufacture, all go to make the story of wire rope, in connection with both the laying and removal of the barrage, one of deep industrial and patriotic interest.

II

When, in the spring of 1918, the Yankee mine layers were sowing the troubled waters between Norway and the Orkneys with three-hundred pound cases of death and destruction at the rate, when at actual work, of one every twelve seconds, it is doubtful if even they stopped to think what it meant in brains and money and time and energy and native honesty and patriotism to produce on time, and in record time, the twelve hundred feet of rope that went out of sight with every mine.

BURYING 6,000,000 FEET OF ROPE IN EACH MINING EXCURSION

Each mining excursion carried and buried six million feet of rope. Like the men who ran the ships and those who dropped the mines, every foot of it did its American duty,



Some of the wire rope used to sweep up the mines
in the North Sea

and the record of the undertaking showed that exacting science and unsparing severity in rejection had made the product practically perfect in spite of all difficulties.

It is unpleasant to think what would have happened if the fine-drawn plummet cords had been defective, or to consider the halt that would have been called to the whole operation if in the later "excursions" the mooring cables had not been ready on the dot and equal to the work they had to do. There were no loose American mines afloat in the North Sea, no mines that did not function, and when the end came and the barrier had to be removed, all were swept up intact. The Navy proved a hundred per cent in time and quality, and so did the rope. Both were a credit to the country that produced them.

IT WAS ALL UP TO AMERICAN MANUFACTURERS

When the barrage project, which the British and many who were not British counted impossible, was finally decided on,

the question of stupendous manufacture confronted the Government. England and the Continent, both overburdened, could not help. It was all up to the American manufacturers.

Mechanically complex as the American mine had come to be, with its varied improvements to increase sensitivity and destructiveness, the problem of construction was in some parts easily solved. By curtailing the automobile industry the mine cases and anchor boxes were supplied promptly and in quantity; contraction of building and electrical construction supplied the electrical devices and trip hooks vital to high effectiveness.

But the wire rope makers had to shoulder the whole burden of their huge task without curtailing the multitude of war industries whose needs were equally imperative. For in the meantime all the multifarious activities in which wire rope is employed were forging ahead in a fever of war production.

ROPE AND STILL MORE
ROPE DEMANDED

The demand for coal and metals never ceased; the mines of coal and copper needed more rope instead of less.

The oil industries had to have rope for drilling and pumping and bailing.

Manufacturing plants were running overtime, calling daily for more rope for power transmission, cranes, hoists and slings.

The lumber camps were demanding larger supply in their effort to get unprecedented quantities of logs to the rail lines, and the shipyards—old ones being extended and enormous new ones being built—could not live without rope in staggering quantities.

Hog Island alone had to have five million feet before it could turn out a ship.

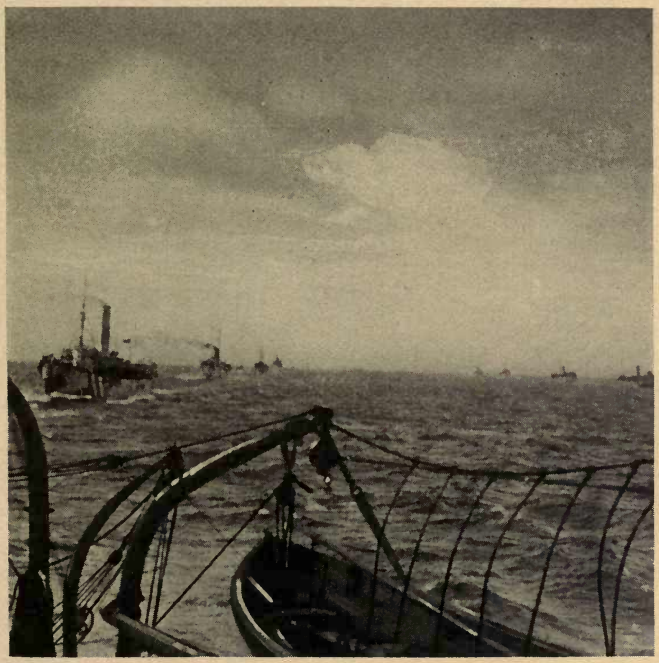
Railroads, elevators, contractors, steel mills, army, navy—all the productive and constructive industries of the country clamored in every mail for more wire rope.

AND THEN—
THE DELUGE

No one has yet begun to forget the conditions that prevailed in every form of manufacture at that time. The thirteen makers of wire rope will never forget it. Sole producers of a commodity without which a mechanical war could not go on any more than it could without guns and powder and ships and men, they received, in January, 1918, an order to produce for the Mine Barrage, at almost superhuman speed, 78,000,000 feet of special rope, in addition to the load they were carrying. It was like ordering the Atlantic Fleet to go in and take Heligoland.

But by May first they had made and shipped, without flaw and without a single delay, rope of various sizes and specifications designed solely for this work and subject to the most exhaustive tests, to equip and anchor a hundred thousand mines.

This was not turning out standard trade stuff for which they were equipped. It was all "different." There was one rope for the



The mine-laying squadron in action

hoisting gear, another for the plummet cord, another for slings, another for ignition cord, another for anchors and so on.

With all these the maximum of strength and the minimum of weight was essential, and the equipment of the factories was not, in the main, adapted to the type of product

contemplated. Production was sharply reduced when a plant which had been making inch and a half cable was set to work on a fine rope measuring but seven-sixteenths of an inch. This situation called for material transfer of equipment.

In addition, the Roebling Company, Trenton, N. J., one of the largest producers, had suffered, by presumably incendiary fires in 1914 and 1915, the loss of two of its largest buildings and faced the new demand with a reduction of fifty per cent in its previous equipment.

III

It was fortunate, to the end of undoing the Hun, that the wire rope industry from the very beginning of the war had learned to pick up loads on short notice and pack them without losing headway.

Prior to 1917 it had manufactured in large

volume for the Allies, and upon America's entrance into the war, the American Iron and Steel Institute, at the request of the Government, formed a committee for the handling and distribution of wire rope. This committee consisted of Karl G. Roebling, of John A. Roebling's Sons Company, Trenton, Chairman; Frank Baackes, General Sales Agent of the American Steel and Wire Company, Trenton; and John L. Broderick, of the firm of Broderick & Bascom, of St. Louis.

The rope makers were called together, the known requirements of the Government explained to them, and data taken on prospective supply of materials. Beginning May 15, 1917, all Government requirements were sent to the sub-committee to be allotted to the various plants on a basis of production.

NO TIME TO CONSIDER THE CLOCK

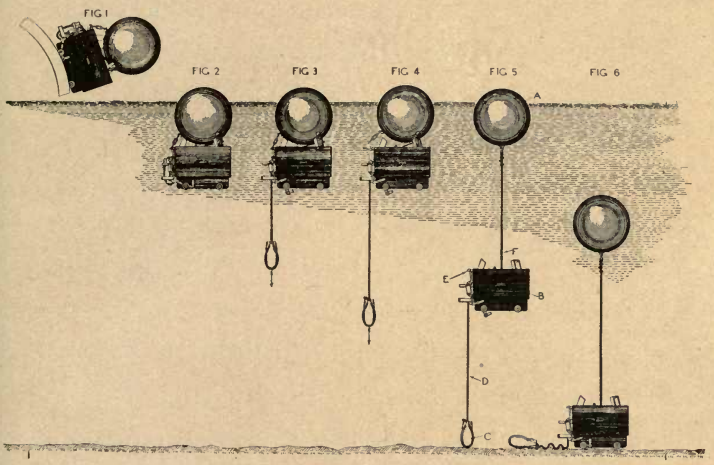
From that time on, neither the members of the committee nor anyone else connected with the wire rope business, had time to

consider the clock. But when the hour of the armistice struck every demand had been met on time, and the productive capacity of the wire manufactories had been increased nearly one hundred per cent. When the big demand of the Navy for the Mine Barrage came, the organization had been schooled in doing the impossible..

To facilitate the distribution of wire and thus hasten production, a sub-committee had been formed by the Institute, with Frank Baackes of the American Steel and Wire Company as its chairman. The close co-operation of these committees in the allotment of requirements and the prompt provision of wire of which the smaller manufacturers were not producers, was a decisive factor in meeting the demand. The rest was work — ceaseless, driving and conscientious.

WIRE ROPE IS MADE WITH A CONSCIENCE

Even in the everyday business of the world, the uses to which wire rope are put



A mine finding its position at the desired depth below the surface of the sea

are pre-eminently those in which the lives and safety of people are constantly at hazard. It is a commodity which cannot be skimped and in which superficial appearance is of no value. Its making involves a stern moral responsibility, and even in the conduct of peace-time manufacture carelessness or parsimony would spell commercial disaster and public reprobation. Wire rope simply has to be made on honor.

The demands of the war intensified this responsibility, since on the perfection of the product hung the lives of our own soldiers and sailors, and, in the last analysis, the outcome of the war.

TWENTY-SIX OPERATIONS IN MANUFACTURE

Wire rope, when it is delivered to the consumer, has passed through twenty-six distinct operations in the making, and at every step of its progress the maker has the alternative of taking a chance on the cheap and easy way, the alternative of dodging the standard or living up to it. The record of the service throughout the war bears ample testimony to the way in which the work of the American factories was done, from the first process to the last.

There is romance in the making of steel, in steel itself, which fairly outdoes half the fiction; but when from the iron ore the various steps have all been taken which lead to the production of the steel ingot, the story of wire rope is barely begun.

From beginning to end, even from the ore stage, it is a story of complex chemistry and rigid rejection of all save the very cream of the material. It is treatment after treatment to eliminate content and conditions by which any element of weakness may creep into the finished product, and there are opportunities all along the way.

ASKING THE UTMOST OF STEEL

But there is steel, and steel. The layman doesn't know this. To him steel is a ponderous generality. The steel girder that goes to make the frame of a skyscraper, the rail that carries a world's commerce—steel in its million everyday uses is only a cousin to the aristocratic stuff that must be singled out for the making of wire rope, with its everlasting tests for tensile strength, elongation, torsion and bending, and every other tax that can be laid upon it, including, at the last, the surety of safety to human life.

Just plain everyday steel won't do. And so scrupulous are the makers in the rejection

of unsuitable material that when the ingot has been reduced to wire ready for the rope-shop, forty-two per cent of it has gone to the scrap heap.

IV

It taxes the credulity of the layman to believe that wire is made by pulling the cold steel of a rod, rolled down from a billet, through a hole in a die of still harder steel. It sounds, again, like invention, that by repetition of this process the metal of a rod is spun down to a diameter of .018 of an inch, and at every redrawing the steel is bathed and baked and cooled and tested and new rejections made.

A REDUCTION OF 512,377 FOLD

When, at last, the wire making is finished the ingot has been reduced 512,377 fold, or

in the proportion of over half a million to one. And the first thing that happens when the wire gets to the rope mill is a grilling test before it is sent to the stock bins.

Then, with what is left, the labor of rope making begins, the drawn steel on its numberless spools whisking through the stranding machines and squeezers, that twist it around its core, like so much cotton yarn. The rope machines repeat the process with the strands. In the special cables used to tether observation balloons, and which have the thickness of a lead pencil but a strength measured in tons, one finds at the center of the rope a core of copper wire which serves for telephonic communication between the observer and the ground.

The entire process from steel rod to finished wire, is long and expensive, often requiring from six to eight weeks of unceasing labor before the steel has been brought to its finished shape and size. With multiplied demand on every hand for special rope with new and unusual specifications, the wire committee of the rope makers woke every morning

with a new stunt before it and a time limit on its performance that taxed every resource.

THE FIGHT FOR MATERIALS

The material problem was a steady fight, since good wire rope can only be made from the best of open-hearth steel requiring a special grade of pig iron with a low content of phosphorus and sulphur. But the same quality of iron was required for shell steel, and the makers of munitions were using it up at a rate never before heard of. So the committees and the organizations behind them worked at high tension, but in the matter of raw material they were living from hand to mouth for months, in the effort to keep abreast of deliveries.

SPECIAL REQUIREMENTS

The immense demand for the Mine Barrage was an extra task, and the making of the rope, with a palpable decline in available labor, was not the whole of the rope manufacturers' contribution. The finishing in-

volved work of a special character. The galvanizing was necessarily superior to any used in ordinary production since the rope was to lie under water for an indefinite length of time and had to be proof against corrosion. If it had rusted off there would have been a flock of TNT packages floating around the North Sea, and wherever else its waters flowed, a tide-borne menace to Allied shipping far more than to the enemy. In every plant where rope was being produced a naval officer was stationed to confer on the work as it progressed and to check up the output with specifications both as to quality and delivery.

In a way, all hands were moving in the dark. The mine itself was in many respects a new device, and was being turned out in vast numbers practically without experimentation. The Government had simply to gamble on the accuracy of its scientific deductions and fix a productive schedule of so many mines a day.

There was a time, owing to the difficulties of transportation, when one of the only two

concerns able to manufacture aircraft cable was supplying eighty per cent of it, and a great share of other product besides. At one interval the crippling of either the Roebling or American Steel and Wire plants would have proved embarrassing, to say the least, to three of the largest and most vital Government war projects.

V

With the requirement for rope, there were concomitant demands for special preparation of the product for shipment, which included its reduction to the lengths required for its various uses.

The plummet cords, for example, had to be cut by the makers to short lengths, dipped in fish oil, and attached to the steel plummet spools in such a way that the sudden stop at the required depth would

not tear them from the spool. This does not sound like so small an item when it is considered that there was a total of 125,000 spools and that deliveries were at the rate of as high as 4,000 a day. All this work was done at the factories of the Roebling Company and the American Steel & Wire Company.

In addition to this, the Roebling force attached about 500,000 sockets and hooks, at the rate of 6,000 a day, and supplied all the four-legged lifting slings.

In all this work there was a constant change of program, necessitated by the requirements and conditions of the mine-laying forces. Endeavoring to accomplish what had been thought impossible, the rope makers, and for that matter the personnel of the Navy also who were engaged on the rope problems, had to fall back on native ingenuity in many junctures in order to overcome obstacles of all sorts which constantly arose.

A FEVERISH TASK
DONE RIGHT

All told, the making of wire rope for war purposes was a feverish task, done in feverish haste, but done, nevertheless, on all sides with marked efficiency and promptitude worthy of commemoration.

VI

It will be noted from the following figures of production that this large volume of excess and highly specialized production was widely distributed throughout the United States; but the producers, and the committees who guided their production, have cause for self-congratulation in the fact that their output was assembled at the right place and at the required time for its great purpose, and that it did the work it was meant to do, in a manner that vindicated the effort of its makers:

NORTH SEA MINE BARRAGE

	FEET OF WIRE ROPE
John A. Roebling's Sons Co., Trenton, N. J.	27,363,200
American Steel & Wire Co., Worcester, Mass.	22,948,270
A. Leschen & Sons Rope Co., St. Louis, Mo.	10,503,000
Broderick & Bascom Rope Co., St. Louis, Mo.	4,241,380
Hazard Mfg. Co., Wilkes-Barre, Pa.	3,975,950
Macomber & Whyte Rope Co., Kenosha, Wis.	3,919,900
Williamsport Wire Rope Co., Williamsport, Pa.	2,982,600
Waterbury Co., Brooklyn, N. Y.	2,818,200
Wright Wire Co., Worcester, Mass.	1,391,520
Total	80,244,020

For the Adriatic sea barrage, rendered unnecessary by virtue of the German capitulation, the figures of production were as follows:

PROPOSED

ADRIATIC SEA MINE BARRAGE

	FEET OF WIRE ROPE
American Steel & Wire Co., Worcester, Mass.	4,995,000
John A. Roebling's Sons Co., Trenton, N. J.	4,473,000
A. Leschen & Sons Rope Co., St. Louis, Mo.	1,875,000
Hazard Mfg. Co., Wilkes-Barre, Pa.	1,110,000
Macomber & Whyte Rope Co., Kenosha, Wis.	885,000
Williamsport Wire Rope Co., Williamsport, Pa.	810,000
Waterbury Co., Brooklyn, N. Y.	420,000
Wright Wire Co., Worcester, Mass.	330,000
Upson & Walton	255,000
	15,153,000

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